PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-140040

(43)Date of publication of application : 22.05.2001

(51)Int.Cl. C22C 38/00
C22C 38/44
C22C 38/50

(21)Application number : 11-323522

(22)Date of filing : 15.11.1999

(71)Applicant : SUMITOMO METAL IND LTD

(72)Inventor : OMURA TOMOHIKO
KUSHIDA TAKAHIRO

(54) LOW CARBON FERRITE-MARTENSITE DUPLEX STAINLESS WELDED STEEL PIPE EXCELLENT IN SULFIDE STRESS CRACKING RESISTANCE

(57)Abstract:

PROBLEM TO BE SOLVED: To produce a ferrite-martensite duplex stainless welded steel pipe exhibiting excellent SSC resistance and toughness in in oil well environment even without executing quenching and tempering heat treatment and annealing heat treatment for a long time to a hot rolled steel sheet as the stock and a steel pipe after pipe making by welding.

SOLUTION: This ferrite-martensite duplex stainless welded steel pipe has a composition containing, by mass, ≤0.02% C, ≤0.04% P, ≤0.01% S, 2 to 8% Ni, 11.5 to 15% Cr, 1.5 to 4% Mo, 0 to 1% Si, 0 to 1 % Mn, 0 to 0.1% sol.Al, 0 to 1.2% Cu, 0 to 0.2% Ti, ≤0.02% N, 0.1% V, and the balance Fe with impurities, and in which the content of ferrite in the metallic structure is 15 to 40 volume %.

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the low carbon ferrite martensite two phase stainless welded steel pipe excellent in the suitable sulfide-proof stress crack nature for a line pipe, an oil well pipe, or piping for chemical processing plants.
[0002]
[Description of the Prior Art]Low carbon martensitic stainless steel is a steel type to which development is advanced as a charge of oil well material in recent years. Corrosion resistance since this steel type has little content of the element in which Cr etc. are more expensive than duplex stainless steel, cheap a steel type and good in Mika of carbon dioxide or carbon dioxide, and the wet environment containing a little mixed gas of gaseous hydrogen sulfide is shown.
[0003]Generally the steel pipe which consists of low carbon martensitic stainless steel is manufactured as seamless steel tubes in many cases. Although seamless steel tubes are evaluated highly about reliability, there are some problems. One is that manufacture of a thin wall tube with a thickness of 10 mm or less is difficult on the principle of the manufacturing-tubes method. It cannot be overemphasized that the direction which is thin meat if possible in the range which intensity allows on the occasion of welding construction of a line pipe is desirable from a viewpoint [reduce the number of laminations at the time of welding, and] of lowering execution cost. Since hot-working nature will fall remarkably and cracks, such as an inside rash, will occur if a ferrite phase deposits in a metal texture, it must be considered as the organization of martensite single phases as much as possible.
[0004]From these reasons, the manufacturing method of the high-corrosion-resistance stainless steel pipe by welding has been developed in recent years. Since low carbon martensitic stainless steel is low carbon, its weldability is good and suitable for it to the line pipe on condition of the girth-weld splice by the Gas tungsten arc weld method (it is described as the GTAW method below), or a gas-metal-arc-welding method (it is described as the GMAW method below).
[0005]For example, in JP,4-191319,A and JP,4-191320,A, the strip steel stock of low carbon martensitic stainless steel is fabricated tubular, and the process which carries out tubulation welding

of the comparison part by an electric-resistance-welding method (it is hereafter described as the ERW method) is indicated. Comparison tubulation welding by the GTAW method or a plasma-arc-welding method (henceforth the PAW method) is also considered by the byway pipe.
[0006]The comparison tubulation welding process using a laser beam welding machine high-output in recent years is also developed, and it compares to JP,9-164425,A, tubes are manufactured by laser welding, and the method of improving corrosion resistance is indicated by performing proper stress relief heat treatment near the weld zone after that.
[0007]The demand of the pipes of a major diameter is also increasing further from seamless steel tubes. About a major-diameter pipe, tubulation welding by a submerged arc welding (it is hereafter described as the SAW method) is also being considered, using steel plates as a raw material.
[0008]Since the welded steel pipe which consists of low carbon martensitic stainless steel is an organization of martensite single phases, they are high intensity and coarse grain structure in as [rolling].
Toughness and corrosion resistance, such as sulfide-proof stress crack (it is henceforth called SSC) nature, will fall.
For this reason, in martensite-single-phases steel, generally, after hot-rolling, prolonged annealing heat treatment must be performed hardening, tempering heat treatment, and for the purpose of softening aimed at obtaining grain refining, and toughness and corrosion resistance must be secured.

[0009]As [hot-rolling] in API standard (American Petroleum Institute standard) 5LC which is the necessary strength as a line pipe, it becomes high intensity in many cases rather than X56 class -X80 class (yield stress is 386 - 655MPa). For the purpose, heat treatment for the purpose of softening becomes indispensable before welding tube manufacturing or after welding tube manufacturing.
[0010]For example, it is shown in JP,4-191319,A that it is necessary that the rolling-up temperature after hot-rolling shall be not less than 600 ** and to perform hardening and heat treatment of annealing after ERW tube manufacturing. However, it becomes production cost quantity to add a heat treatment process in this way.
[0011]
[Problem(s) to be Solved by the Invention]There is SUBJECT of this invention in providing the welded steel pipe which demonstrates the SSC-proof nature which was excellent in them in oil well environment even if it performed neither hardening, tempering heat treatment nor prolonged annealing heat treatment to the hot rolled sheet steel of a raw material, or the steel pipe after welding tube manufacturing, and toughness.
[0012]
[Means for Solving the Problem]If it is a premise to use a product also as [hot-rolling] as a result of experimenting and inquiring wholeheartedly in order that this invention persons may solve an aforementioned problem, When considering it as a metal texture of a two phase of a ferrite phase which deposited a ferrite phase at a predetermined rate in a martensitic phase which is a host phase, and a martensitic phase, knowledge that control of high-intensity-izing can be performed and good

SSC-proof nature is moreover obtained also as [hot-rolling] was acquired. This invention was made based on such knowledge, and the gist is as follows.

[0013]By mass %, (1) C:0.02% or less, P:0.04% or less, S:0.01% or less, nickel: 2-8%, Cr:11.5-15%, Mo:1.5-4%, Si : 0 to 1%, Mn: 0-1%, sol.aluminum:0-0.1%, Cu : 0 to 1.2%, Ti: A low carbon ferrite martensite two phase stainless welded steel pipe 0 to 0.2%, N:0.02% or less, and V:0.1% or less were contained, the remainder consisted of Fe and an impurity, and a ferrite content in a metal texture excelled [stainless welded steel pipe] in sulfide-proof stress crack nature which is 15 to 40% in volume %.

[0014]Generally, if a ferrite phase deposits in martensitic stainless steel, it is said that performances, such as toughness and corrosion resistance, deteriorate. For example, since ferritic stainless steel is [toughness] non-** about toughness, if a ferrite phase deposits in mull sugarbeet system toss ten loess steel, it will be presumed easily that toughness deteriorates. When a ferrite phase deposits about corrosion resistance, it is that it is expected that absorb Cr and Mo which are elements effective in protection of an anticorrosion coat from martensite of a host phase, and it also becomes impossible for the corrosion resistance of a host phase to fully secure. Therefore, although an example which utilized a deposit of a ferrite phase with a steel pipe used in an oil well environment did not have the former, when this invention persons compared a ferrite phase with a martensitic phase, they did the following examinations paying attention to being a softening phase.

[0015]By mass %, C:0.012%, Si:0.43%, Mn:0.51%, Mo: 2.53%, sol.aluminum:0.033%, Ti : 0.034%, nickel : Make 3.55% and V:0.02% into a fundamental component, and a Cr content 10 to 17%, A low carbon martensitic stainless steel to which NI content changed variously 0 to 10% and Mo content in 0 to 5% of range was ingoted and cogged, and it was considered as slab, and cooking temperature was variously changed to 1100-1250 **, and was hot-rolled. A tensile test, a Charpy impact test, and SSC-proof sex test were carried out using this hot-rolled steel plate.

[0016]Drawing 1 is a figure showing a relation of a ferrite content and yield stress which were obtained from a tensile test result. Intensity is falling as a ferrite content in martensite increases.

[0017]Drawing 2 is a figure showing a relation of a ferrite content (volume %) and fracture transition temperature which were obtained from a Charpy impact test result. In transition temperature, at not less than 15%, a ferrite content has become less than -20 **. As a result of investigating a metal texture, even if it was also as [rolling], when a ferrite content was 15 to 80%, it had become a very fine grain organization.

[0018]Drawing 3 is a figure showing relation between a ferrite content (volume %) obtained by SSC-proof sex-test examination, and a hydrogen sulfide partial pressure. Since it becomes fine texture by not less than 15% of a ferrite content like toughness, good SSC-proof nature is shown. However, from a viewpoint of the protection nature of an anticorrosion coat, since a ferrite phase absorbs Cr and Mo from a martensitic phase of a host phase and the corrosion resistance of a martensitic phase was reduced indirectly, when a ferrite content exceeded 40%, it turned out that SSC-proof nature falls on the contrary.

[0019]

[Embodiment of the Invention]Hereafter, the chemical composition and the metal texture which are specified by this invention are explained in detail. The display of the quantity of mass % and a metal texture of all % of the content of a chemical entity is volume %.

[0020]As C:0.02%or less C is low from a viewpoint of securing weldability, it is more desirable. However, as for reducing the amount of C recklessly, since it is accompanied by cost rise, it is desirable to consider it as 0.002% or more from a viewpoint of economical efficiency. Since remarkable hardening is caused in [become / the intensity of a martensitic phase / too much / high] a heat affected zone (it is hereafter described as HAZ) at the time of welding and SSC-proof nature was reduced when it exceeded 0.02%, the maximum was made into 0.02%.

[0021]P:0.04%or less P exists unescapable in steel as an impurity, and a segregation is carried out to a grain boundary, and it degrades SSC-proof nature. Since degradation of SSC-proof nature will become remarkable if the content exceeds 0.04% especially, it is necessary to make content 0.04% or less. As for the content of P, in order to improve SSC-proof nature, it is desirable to make it as low as possible.

[0022]Although S:0.01%or less S exists unescapable in steel as an impurity like P, it reduces SSC-proof nature to a grain boundary carrying out a segregation and by generating the inclusion of a sulfide system so much. If the content exceeds 0.01%, since the fall of SSC-proof nature is remarkable, it needs to make content 0.01% or less. As for the content of S, in order to improve SSC-proof nature, it is desirable to make it as low as possible.

[0023]nickel: 2 to 8%or less nickel is effective in making the amount of martensite increase like Mn, and it is necessary to make it contain not less than 2% from this viewpoint. On the other hand, if it is made to contain superfluously, it will become expensive steel and economical efficiency will be spoiled, and the intensity rise of a martensitic phase is caused by solid solution strengthening, and SSC-proof nature is reduced. The maximum was made into 8% from this viewpoint.

[0024]Cr: Cr is an element which protects an anticorrosion coat and improves SSC-proof nature 11.5 to 15%. In order to acquire this effect, it is necessary to make it contain not less than 11.5%. On the other hand, since Cr is a ferrite stabilization element, if it is made to contain superfluously exceeding 15%, it will be necessary to increase the quantity of alloy elements, such as expensive nickel which is a martensite stabilization element, and economical efficiency will be spoiled. The maximum was made into 15% from this viewpoint.

[0025]Mo: 1.5 to 4%or less Mo is an element which protects an anticorrosion coat and improves SSC-proof nature. In order to acquire this effect, it is preferred to use 1.55 or more. Since it is a ferrite stabilization element like Cr, if it is made to contain too much, it will be necessary to increase the quantity of alloy elements, such as expensive nickel which is a martensite stabilization element, and economical efficiency will be spoiled. The maximum was made into 4% from this viewpoint.

[0026]Si: Although it is not necessary to add, especially 0 to 1%or less Si is effective in the deoxidation of molten steel, if it adds. It is preferred to consider it as 0.2% or more, for acquiring the effect. However, since the content lowers the grain community intensity exceeding 1% and reduces SSC-proof nature, the maximum is 1%.

[0027]Mn: Although it is not necessary to add Mn 0 to 1% or less, if it adds, there is an effect which raises the rate that martensite occupies. When adding, it is preferred to make it contain 0.2% or more. However, SSC-proof nature is reduced by weakening the grain community intensity made to contain exceeding 1%, or carrying out the activity dissolution in hydrogen sulfide. Therefore, the maximum was made into 1%. The desirable amount of Mn is 0.05% or less.
[0028]sol.aluminum: Although it is not necessary to add, 0.1%or less aluminum is effective in the deoxidation of molten steel, if it adds. In order to acquire the effect, it is preferred to consider it as 0.02% or more. However, if it is made to contain exceeding 0.1%, big and rough aluminum system inclusion will increase in number, and SSC-proof nature will fall. Therefore, the maximum was made into 0.1%.
[0029]Ti: Although Ti is made to contain as occasion demands 0 to 0.2%, if it is made to contain, there is an effect which fixes as TiN N which is an impurity in steel. Superfluous Ti serves as carbide, carries out the trap of the C, and controls hardening in HAZ of a girth-weld part rather than needing for N immobilization. However, since processability would be reduced or carbon nitride itself would serve as a starting point of SSC if it is made to contain exceeding 0.2%, the maximum was made into 0.2%. A desirable minimum is 0.1%.
[0030]V: 0.1%or less V is an element mixed unescapable as an impurity from dissolution loss in quantity, and is **. Since it became high intensity too much since detailed VC deposited when it exceeded especially 0.1%, and SSC-proof nature fell, the maximum was made into 0.1%. The desirable amount of V is 0.05% or less.
[0031]If N:0.02%or less N exists in steel as an impurity and the content exceeds 0.02%, hot-working nature will be spoiled, and manufacture will become difficult, and the intensity rise of a martensitic phase will be caused, and SSC-proof nature will fall. The desirable amount of N is 0.01% or less.
[0032]Cu: Although Cu is made to contain as occasion demands 0 to 1.2%, if it is made to contain, there is an effect which improves SSC-proof nature. In order to acquire the effect, it is preferred to consider it as 0.1% or more. On the other hand, if it exceeds 1.2%, the effect to corrosion resistance will be saturated and SSC-proof nature will be reduced on the contrary by the intensity rise of a martensitic phase. The maximum was made into 1.2% from this viewpoint.
[0033]Metal texture: Since heat treatment for intensity adjustment is needed after hot-rolling or welding tube manufacturing if a metal texture is made into martensite 1 phase, consider it as the two phase structure of a ferrite phase and a martensitic phase.
[0034]If two phase structure is used, the grain growth of each phase is controlled, also as [rolling], it will become a fine grain organization extremely and toughness and SSC-proof nature will be improved.
[0035]It is as [rolling], and in order to consider it as 655 or less MPa of yield strength and to acquire good toughness, it is necessary to deposit not less than 15% of ferrite phase. On the other hand, from a viewpoint of SSC-proof nature, if a ferrite phase exceeds 40%, Cr and Mo will be absorbed from the martensitic phase of a host phase, and SSC-proof nature will be reduced indirectly. The volume fraction of the ferrite phase was made into 15 to 40% from this viewpoint.

[0036]The combination of the content of Cr and Mo and the cooking temperature for hot-rolling can perform adjustment of a ferrite content. For example, when increasing ullage of a ferrite, it is good to make [many] Cr of a ferrite former, and Mo content, and to make cooking temperature high.
[0037]Next, the manufacturing method of a welded steel pipe is explained below.
[0038]The hot rolled sheet steel or steel plates manufactured with the usual slabbing and hot-rolling is used for the stock steel sheet of a welded steel pipe. What is necessary is to roll by the usual method and just to finish about the hot-rolling method, after heating to the usual cooking temperature, for example, the not less than 1100 ** range of 1250 ** or less. However, in order to adjust a ferrite content as mentioned above, in consideration of chemical composition, there is texture ****** about cooking temperature. A short time may be annealed after rolling for strong fine adjustment. Neither hardening, tempering heat treatment nor prolonged annealing heat treatment suits the purpose of this invention desirably from a viewpoint of economical efficiency.
[0039]Hot rolled sheet steel or steel plates are cut to the almost same width as target steel pipe peripheral length, weld the portion which was fabricated cylindrical and compared, and use it as a welded steel pipe. As long as it is a welding process with which there is no restriction in particular also about a welding process, and the performance of a weld zone is guaranteed, what kind of method may be used. As long as it is a thin wall tube, arc welding processes, such as the GTAW method, the GMAW method, a plasma-arc-welding method, may be used, and the ERW method may be used from a viewpoint of tube-manufacturing cost reduction. An electron-beam-welding method and a laser-welding method may be used from a viewpoint of quality reservation of a weld zone.
[0040]What is necessary is to fabricate hot rolled sheet steel with processing devices, such as a forming roll group, in the shape of an open pipe in tubulation welding, to compare hoop iron both edge of both by the squeeze roll or other means to it, and just to take the technique of joining this comparison part and carrying out tubulation welding to it. For the improvement in tube-manufacturing speed, after preheating by the high frequency heating means using the tubular induction heating coil or contact tip which is used by the electric-resistance-welding method and in which local heating is possible, tubulation welding may be performed. After welding tube manufacturing, a high frequency heating means may be used and local heat treatment aiming at organization recovery of a weld zone may be performed.
[0041]To manufacture of a heavy-gage steel pipe, tube manufacturing by SAW is preferred. It is as [welding] and what is necessary is just to use techniques, such as considering it as a product, after fabricating steel plates tubular gradually with usual C press, U press, and O press and carrying out welding tube manufacturing of the comparison part by SAW. The ingredient of a welding condition or a weld metal should just be the technique of the ability to obtain desired performance, and limitation in particular is not carried out.
[0042]
[Example]Steel of 16 sorts of chemical composition shown in Table 1 was ingoted, the steel ingot was forged, and it was considered as slab. Sign A-H of the table has chemical composition within limits specified by this invention, and 1-8 are outside a stipulated range. After changing each slab variously

and heating it in a temperature requirement (1100 ** - 1250 **), it hot-rolled and was considered as hot rolled sheet steel. It is for adjusting a ferrite content to have changed cooking temperature.

[0043]

[Table 1]

表1

記号	化学組成（質量%）（残部：Feと不純物）												
	C	Si	Mn	P	S	Cr	Mo	Al	Ti	Ni	Cu	V	N
A	0.003	0.42	0.45	0.012	0.0017	11.8	1.89	0.035	0.035	3.02	-	0.01	0.004
B	0.012	0.43	0.51	0.013	0.0045	11.9	2.53	0.033	0.034	3.55	-	0.02	0.005
C	0.022	0.23	0.98	0.030	0.0043	12.1	3.05	0.048	0.031	4.01	1.0	0.01	0.001
D	0.007	0.41	0.94	0.015	0.0015	13.0	2.07	0.045	0.032	4.52	-	0.02	0.004
E	0.011	0.43	0.54	0.021	0.0045	13.1	2.48	0.038	0.016	5.04	0.5	0.03	0.003
F	0.009	0.45	1.98	0.013	0.0028	13.1	3.03	0.049	0.154	6.05	-	0.01	0.004
G	0.008	0.21	0.48	0.023	0.0019	14.0	3.04	0.054	0.015	7.05	-	0.04	0.004
H	0.013	0.23	0.51	0.028	0.0018	14.3	3.87	0.034	0.034	7.89	-	0.01	0.008
1	0.031*	0.45	0.54	0.022	0.0023	12.0	1.93	0.033	0.031	3.03	-	0.01	0.004
2	0.011	0.43	0.45	0.064*	0.0034	12.0	2.08	0.045	0.018	4.02	1.1	0.01	0.005
3	0.008	0.45	0.53	0.021	0.0121*	12.1	2.51	0.044	0.035	5.05	-	0.04	0.004
4	0.009	0.23	0.48	0.023	0.0028	11.3*	2.01	0.052	0.032	3.01	0.5	0.03	0.003
5	0.013	0.29	0.54	0.021	0.0045	15.8*	3.54	0.088	0.016	5.07	0.4	0.01	0.004
6	0.015	0.45	0.51	0.019	0.0019	13.0	4.20*	0.045	0.018	5.04	-	0.05	0.004
7	0.009	0.48	0.57	0.024	0.0018	13.1	3.77	0.112*	0.033	6.08	-	0.04	0.004
8	0.011	0.18	0.42	0.021	0.0045	12.0	2.54	0.032	0.035	8.81*	-	0.03	0.003

* 本発明で規定する範囲外を示す

[0044]The welded tube was manufactured by laser welding, SAW, ERW, PAW, and GTAW by being made from the hot-rolled each steel plate. Laser welding and ERWPAW performed tubulation welding, without using a filler metal. GTAW and SAW performed tubulation welding, using the ferrite austenite duplex stainless steel of 22Cr system or a 25Cr system as a filler metal. Altogether, stress relief heat treatment after welding was not carried out.

[0045]The volume fraction of the ferrite phase in a metal texture made the Vilela reagent corrode the ****** material of the hot-rolled steel plate section, carried out texture observation, and measured it in point counting. Each steel plate measured three sections, computed the average value, and was made into the volume fraction.

[0046]From hot rolled sheet steel, the round bar test piece for tensile test of the various size according to the thickness of the stock steel sheet was extracted crosswise [the], the tensile test was carried out at ordinary temperature, and yield strength (YS) was measured.

[0047]After extracting the test piece for Charpy impact test according to the thickness of the stock steel sheet crosswise [of hot rolled sheet steel] and carrying out an impact test at a various temperature, fracture surface observation was carried out and fracture transition temperature (vTs) was measured.

[0048]furthermore -- an SSC examination extracts the piece of a stress corrosion test 2 mm in thickness, 10 mm in width, and 75 mm in length in the direction of the cross direction from the base material part and weld zone of a welded tube -- four-point bending -- a law -- load of 100% of the stress of YS of raw material steel was carried out by the distortion method, it was immersed into test

liquid for 336 hours, and the existence of generating of SSC was investigated. The 5% NaCl aqueous solution which saturated 0.001 - 0.01MPa and H_2S (CO_2 balance) in test liquid and which carried out specified quantity addition of the acetic acid-sodium acetate, and adjusted pH to 3.5 was used.

[0049]These test results are shown in Table 2 and 3.

[0050]

[Table 2]

表２

試験番号	鋼記号	肉厚 (mm)	製管方法	フェライト量 (体積%)	降伏応力 (MPa)	遷移温度 (℃)	耐SSC性 0.001 MPa	耐SSC性 0.01 MPa	区分
1	A	25.0	SAW	25	620	-40	○	○	
2	B	25.0	〃	35	590	-50	○	○	
3	C	25.0	〃	28	607	-50	○	○	
4	D	25.0	〃	23	627	-40	○	○	
5	E	25.0	〃	31	607	-50	○	○	本
6	F	25.0	〃	38	558	-50	○	○	
7	G	25.0	〃	31	607	-50	○	○	発
8	H	25.0	〃	32	579	-50	○	○	
9	B	25.0	レーザ	18	648	-40	○	○	明
10	E	6.0	〃	31	607	-50	○	○	
11	G	6.0	〃	25	558	-40	○	○	例
12	B	6.0	ERW	24	565	-40	○	○	
13	E	5.5	〃	31	572	-50	○	○	
14	G	5.5	〃	29	579	-50	○	○	
15	B	5.5	PAW	24	558	-40	○	○	
16	E	5.5	〃	25	572	-50	○	○	
17	G	5.5	〃	26	593	-40	○	○	
18	B	5.5	GTAW	26	558	-50	○	○	
19	E	3.5	〃	34	565	-50	○	○	
20	G	3.5	〃	35	565	-50	○	○	

[0051]

[Table 3]

表３

試験番号	鋼記号	肉厚 (mm)	製管方法	フェライト量 (体積%)	降伏応力 (MPa)	遷移温度 (℃)	耐SSC性 0.001 MPa	耐SSC性 0.01 MPa	区分
21	B	6	レーザ	10*	696	-20	×	×	
22	E	6	〃	11*	703	-20	○	×	
23	G	6	〃	10*	682	-20	×	×	
24	B	6	〃	48*	517	-50	○	×	
25	E	6	〃	58*	434	-50	×	×	
26	G	6	〃	54*	427	-50	○	×	
27	B	25	SAW	11*	696	-20	○	×	比
28	E	25	〃	12*	675	-20	○	×	
29	G	25	〃	9*	745	-10	×	×	較
30	B	25	〃	69*	448	-40	×	×	
31	E	25	〃	58*	427	-50	○	×	例
32	G	25	〃	53*	421	-40	○	×	
33	1*	25	〃	23*	558	-40	○	×	
34	2*	25	〃	31*	565	0	×	×	
35	3*	25	〃	25	579	0	×	×	
36	4*	25	〃	26	572	-50	×	×	
37	5*	25	〃	64*	427	-50	×	×	
38	6*	25	〃	61*	434	-50	×	×	
39	7*	25	〃	19	627	-30	×	×	
40	8*	25	〃	0*	758	0	×	×	

* 本発明で規定する範囲外を示す
鋼記号欄の*は、化学組成が規定範囲外

[0052]The valuation basis of the SSC-proof column in Table 2 and Table 3 made that in which fitness "O" and SSC generated what generating of SSC was not accepted to non-** "x."
[0053]With steel provided with the chemical composition within the limits and metal texture which are specified by this invention, YS is excellent in toughness and corrosion resistance at 648 or less MPa so that more clearly than Table 2.
[0054]On the other hand, even if the chemical composition of the test numbers 21-32 occurs within limits specified by this invention as shown in Table 3, if a ferrite content is outside a stipulated range, toughness, intensity, and the one or more characteristics of SSC-proof nature will not bear practical use bad. About the test numbers 33-40 besides the range which chemical composition specifies by this invention, it is inferior to SSC-proof nature, and toughness and the characteristic of yield stress are bad.
[0055]
[Effect of the Invention]Being able to provide cheaply the welded steel pipe which demonstrates the SSC-proof nature which performed neither hardening, tempering heat treatment nor prolonged annealing heat treatment to the hot rolled sheet steel of a raw material, or the steel pipe after welding tube manufacturing, and was excellent in them in oil well environment, and toughness, the industrial value is size.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]A low carbon ferrite martensite two phase stainless welded steel pipe excellent in sulfide-proof stress crack nature characterized by the following.
By mass %, C:0.02% or less, P:0.04% or less, S:0.01% or less, nickel: 2-8%, Cr:11.5-15%, Mo:1.5-4%, Si:0-1%, Mn:0-1%, sol.aluminum:0-0.1%, Cu:0-1.2%, Ti: 0 to 0.2%, N:0.02% or less, V:0.1% or less.
It consists of Fe and an impurity, a ferrite content in a metal texture is volume %, and the remainder is 15 to 40%.

[Translation done.]